MECHANICAL ENGINEER

NUMERICAL PREDICTION OF THE IMPACT OF NON-UNIFORM LEADING EDGE COATINGS ON THE AERODYNAMIC PERFORMANCE OF COMPRESSOR AIRFOILS

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A computational fluid dynamic (CFD) investigation is presented that provides predictions of the aerodynamic impact of uniform and non-uniform coatings applied to the leading edge of a compressor airfoil in a cascade. Using a National Advisory Committee for Aeronautics (NACA) 65(12)10 airfoil, coating profiles of varying leading edge non-uniformity were added. This non-uniformity is typical of that expected due to fluid being drawn away from the leading edge during the coating process. The CFD code, RVCQ3D, is a steady, quasi-three-dimensional Reynolds Averaged Navier-Stokes (RANS) solver. A k-omega turbulence model is used for the Reynolds' Stress closure. The code predicts that these changes in leading edge shape can lead to alternating pressure gradients in the first few percent of chord that create small separation bubbles and possibly early transition to turbulence. The change in total pressure loss and trailing edge deviation are presented as a function of the coating non-uniformity parameter. Results are presented for six leading edge profiles over a range of incidences and inlet Mach numbers from 0.6 to 0.8. The Reynolds number was 600,000 and free-stream turbulence was 6%. A two-dimensional map is provided that shows the allowable degree of coating non-uniformity as a function of incidence and inlet Mach number.

KEYWORDS: Compressor Aerodynamics, Leading Edges, Separation Bubbles, Computational Fluid Dynamics, CFD, Coated Airfoils

EXPERIMENTS WITH THE *REMUS* AUV

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This thesis centers on actual field operations and post-mission analysis of data acquired using a Remote Environmental Monitoring Unit (REMUS) Autonomous Underwater Vehicle (AUV) operated by the Naval Postgraduate School Center for Autonomous Underwater Vehicle Research. It was one of many platforms that were utilized for data collection during Autonomous Oceanographic Sampling Network II (AOSN II), an Office of Naval Research (ONR) sponsored exercise for dynamic oceanographic data taking and model based analysis using adaptive sampling. The vehicle's ability to collect oceanographic data consisting of conductivity, temperature, and salinity during this experiment is assessed and problem areas are investigated. Of particular interest are the temperature and salinity profiles measured from long transect runs of 18 kilometer length into the southern parts of Monterey Bay. Experimentation with the REMUS as a mine detection asset was also performed. The design and development of the mine hunting experiment is discussed, as well as results and analysis. Of particular interest in this portion of the work is the issue relating to repeatability and precision of contact localization, obtained from vehicle position and sidescan sonar measurements.

KEYWORDS: REMUS, AUV, Autonomous Underwater Vehicle, Mine Hunting, AOSN